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Ľudovít KUPČA[1], Martin BŘEZINA[2]

STATUS OF THE AGEING MANAGEMENT APPLICATION IN THE SLOVAK REPUBLIC NPP'S

STAV APLIKÁCIE RIADENÉHO STARNUTIA V JE SLOVENSKEJ REPUBLIKY

[1] *VUJE Inc.; Trnava, Slovak Republic, contact author, e-mail:kupca@vuje.sk*
[2] *VUJE Inc.; Trnava, Slovak Republic*

Abstract

An ageing management program begun to be systematically implemented under provisions of the Slovak Electricity Company environment since 1996, when the Safety Analysis Report after 10 years of Unit 3 & 4 operation had been submitted to the Slovak National Regulatory Authority. By then, the effects of known degradation mechanisms, of which various equipment and components are prone to, were assessed through the use of existing particular programs; e.g. RPV's irradiation embrittlement by a standard design-built surveillance specimen program and neutron dosimetry calculations, then the low-cycle fatigue of the main primary components/pipelines hot spots applying computational analyses as well as the evaluation of an erosion-corrosion effect on wall thinning of critical secondary piping components. As the world's trends and progress still have continued further towards the use of more sophisticated software, hardware, diagnostics, analyses, procedures and computing, given methodologies have been modernized and the idea of operational loads on evaluated systems, structures and components – particularly their critical hot spots - has been several times revised. After issuing of country's nuclear authority safety guide BNS I.9.2/2001 "Ageing management of nuclear power plants. Requirements." in 2001, a project called "Ageing management and lifetime optimization of nuclear power plants with WWER 440 units" had been introduced, in collaboration with the nuclear power plants research institute (VUJE) it has been developed within the period of 2002-2005. At present the results of this project are in different stage of implementation at Bohunice V-2 and Mochovce Units 1,2 NPPs. It is planed to apply them at the Units 3,4 of Mochovce NPP, which are under construction now.

Abstrakt

Počiatky systematickej realizácie programu riadeného starnutia v Slovenských elektrárňach patria do roku 1996, keď na ÚJD SR bola odoslaná Bezpečnostná správa 3. a 4. bloku po 10 ročnej prevádzke. V tej dobe boli vplyvy známych degradačných mechanizmov na zariadenia a komponenty hodnotené použitím existujúcich programov; napr. pre hodnotenie krehnutia tlakovej nádoby reaktora bol použitý štandardný program overovacích vzoriek dodaný výrobcom, podobne bola riešená aj neutrónová dozimetria, nízkocyklová únava hlavných častí primárneho okruhu/potrubia použitím výpočtových analýz, rovnako ako erózne-korózny vplyv na dôležité komponenty potrubí sekundárneho okruhu. Keďže svetové trendy smerujú k stále sofistikovanejšiemu softwaru, hardwaru, diagnostike, analýzam, postupom a výpočtom, dané metódy boli modernizované a predstavy o prevádzkových záťažách na hodnotené systémy, konštrukcie a komponenty – predovšetkým ich kritické miesta – boli niekoľko ráz revidované. Po vydaní Bezpečnostného návodu BNS I.9.2/2001 "Riadenie starnutia jadrových elektrární – Požiadavky" v roku 2001 bol pripravený projekt „Riadené starnutie a optimalizácia životnosti jadrových elektrární s blokmi VVER-440", ktorý bol riešený v spolupráci s VUJE v období 2002-2005. Výsledky riešenia tohto projektu sú v súčasnosti v rozličných štádiách realizácie na JE V-2 Jaslovské Bohunice i v EMO 1,2 a budú súčasťou dostavby EMO 3,4.

Key words: Nuclear Power Plant, Ageing Management, WWER-440

1. Introduction

An ageing management program begun to be systematically implemented in the Slovak Electricity Company environment since 1996. The effects of known degradation mechanisms, for various equipment and components, were assessed through the use of existing particular monitoring programs; e.g. surveillance specimen program for RPV's irradiation embrittlement, then the low-cycle fatigue of the main primary components computational analyses as well as the evaluation of an erosion-corrosion effect for critical secondary piping components. As the world's trends and progress still have continued further towards the use of more sophisticated software, hardware, diagnostics, analyses, procedures and computing, given methodologies have been modernized and the idea of operational loads on evaluated systems, structures and components – particularly their critical hot spots - has been several times revised.

2. The brief description of ageing management process

The ageing management is dynamic process used for the evaluation of real state of NPPs System, Structures, and Components (SSC) by implementation of appropriate technical, research and diagnostic tools. The aim of these activities is to prepare, plan and implement the effective operational and maintenance provisions. The scheme of ageing management is on the figure 1.

To achieve the planned aims the ageing management must be organized as systematic process with following stages:

A. The understanding of SSCs ageing. This is the key for effective ageing management in witch must be understood:

- the material properties,
- the operational loads of SSCs,
- the degradation mechanisms,
- the hot spots of degradation ,
- the indicators of real state,
- the issues of degradation processes.

B. The coordination od SSCs ageing program - this is mainly the planning of all activities:

- the documentation of regulatory requirements and safety criteria,
- the documentation of appropriate activities,
- optimization of ageing management program on the base of actual information and evaluation.

C. The operation of SSCs - the main goal of this stage is suppression of expected degradation processes with activities:

- the operation by the operational limits and conditions,
- the chemical regimes management,
- the operational environment regulation,
- the operational history monitoring including the transition processes.

D. The monitoring, diagnostic and SSCs evaluation. The corrective measures for non-acceptable degradation is the goal of the activities into this stage including:

- operational controls,
- surveillance programs,
- leakage detection,
- testing and calibration,
- operational function evaluation,
- the data acquisition and documentation.

E. The SSCs maintenance. Activities in this stage have the goal to improve the ageing management programs effectivity as:

- proactive maintenance,
- corrective maintenance,
- preventive maintenance,
- spare parts delivery,
- the modifications and changes of SCCs,
- the maintenance history.

3. Research and development support for the ageing management

For this purpose was prepared special project named "Ageing management and lifetime optimization of nuclear power plants with WWER 440 units" running during the years 2002 till 2005. This complex project was prepared with close cooperation of all institutes involved in it with respect of IAEA recommendations [2] and regulatory authority too. The main goals of this project were following:

- Identify the ageing mechanisms of the safety related components.
- Development of the database for the rest of lifetime evaluation.
- Extension of the operated monitoring systems for important degradation mechanisms.
- Development of the ageing management program for minimizing the degradation of the safety related components.
- Development of the software tools, which have implemented the ageing processes.
- Development of the software for the technical and economical evaluation of the NPP components repair and replacement from the lifetime prolongation point of view.

Project's particular tasks were dealing with:

- the research and analysis of ageing mechanisms,
- the ageing management programs,
- the research on advanced monitoring systems of degradation processes,
- the legislation base for AMP's,
- the AM database,
- the evaluation of the plant's long-term operation conditions efficiency,
- legislative conditions for an approval on the NPP operation beyond design lifetime.

The project itself has set a basis for an implementation of an ageing management system under provisions of the Slovak Electricity Company environment to resolve the following issues:

- defining an effective ageing management system,
- listing of critical SSC`s including their known degradation mechanisms,
- fundamentals of SSC`s and ageing management programs establishment.

The ageing management programs evaluation is regularly performed per annum and within 10 years period. More detail information is involved in special publication [3].

4. Conclusions

According to the actual results of the ageing management programs evaluation is possible to conclude, that this system will meet the requirements of:

- Nuclear Regulatory Authority of the Slovak Republic (UJD SR),
- recommendations of IAEA,
- internationally approved standards used for evaluation of thermal ageing,
- the possibility to compare the results between the operated individual units not in Slovak Republic only, but with the other nuclear technologies in the world too.

References

[1]. Borák J., Kupča Ľ., Jurčo V., Havavka M.: Ageing management of Bohunice npp equipment, version 13, 2006.

[2]. IAEA: Ageing management for nuclear power plants and research reactors, Safety Guide NS G DS382, 2005.

[3]. Kupča, Ľ. et. al.: Monitoring programs of the safety related components NPP's WWER -440, In: The Safety Of Nuclear Energy, 2007, 15 (53), 3/4

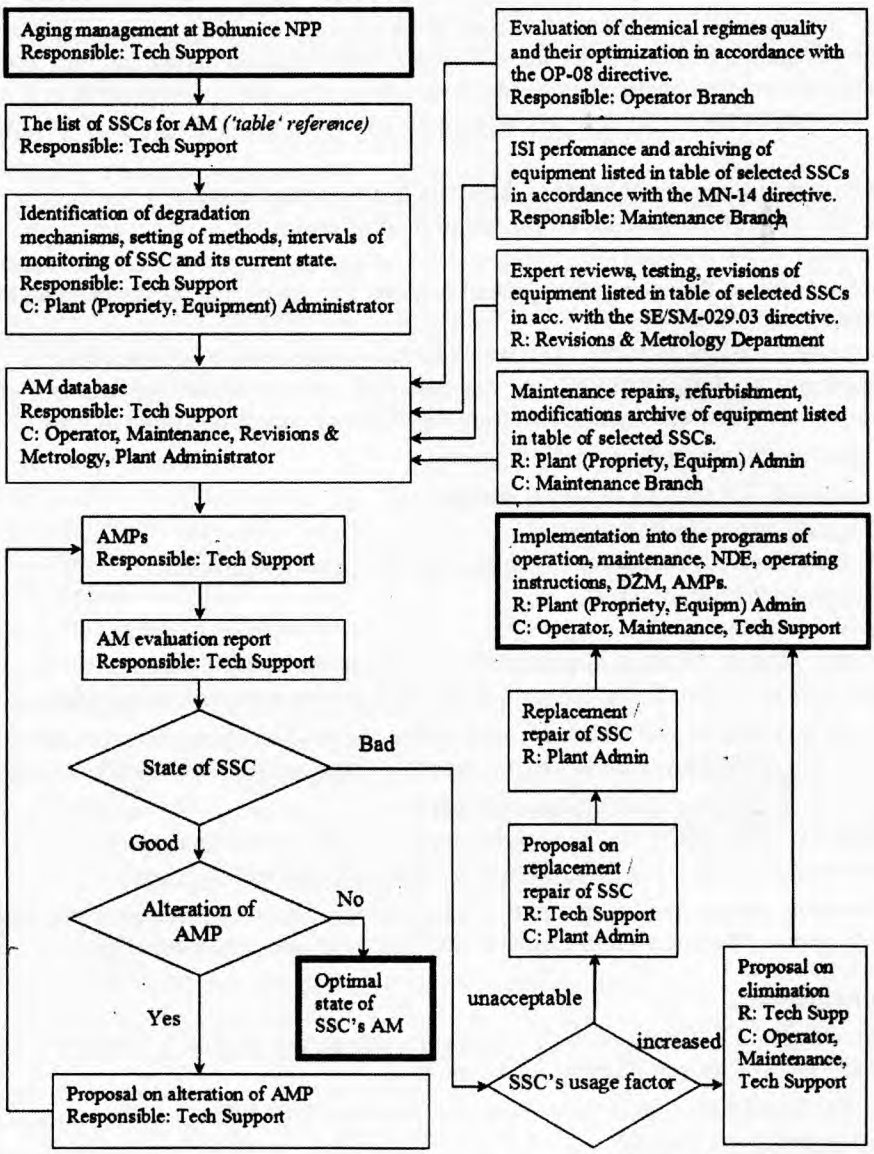

Fig. 1 Proposed steps within the ageing management of critical SSC's at Bohunice nuclear power plant according to [1]

Reviewer: Prof. Ing. Miroslav Tvrdý, DrSc., VŠB – TU Ostrava